



Portable Analyzer for Chlorinated Compounds



Developer: Transducer Research, Inc.
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Crosscutting Area: CMST

Subsurface
Contaminants
FOCUS AREA

Problem:

Widespread use of chlorinated solvents such as carbon tetrachloride, trichloroethylene, and perchloroethylene has resulted in contamination problems in the air, soil, and ground water at many Department of Energy (DOE) sites. Characterizing the extent of chlorinated hydrocarbon contamination, controlling remediation treatment processes, and monitoring of regulatory compliance frequently require hundreds or thousands of analyses. Traditional sampling and off-site laboratory analysis methods are expensive and do not provide the immediate results needed for health and safety protection and effective process control. Currently available field-usable, portable monitoring systems do not specifically measure for chlorinated hydrocarbons at the low concentrations and precision needed. Current field monitoring systems have not demonstrated reliability or ease of use by field technicians.

Solution:

A fully portable, hand-held, solid-state-sensor-based monitoring system that measures low concentrations of chlorinated

organic compounds has been developed and is available for field demonstration. The system is capable of detecting chlorinated hydrocarbons in the range of 0.2-25 ppm and up to 500 ppm with an internal dilution feature that is incorporated into the instrument. The portable analyzer can be used to analyze samples from start-up in less than 15 minutes or in a continuous monitoring mode in 10 minutes or less. The system is designed for field use by technicians wearing protective clothing and for easy maintenance. The instrument can be operated from an AC line or from an internal battery.

Benefits:

- Selective detection of chlorinated organics in mixture with other hydrocarbons
- Reduced analytical costs through screening to reduce the number of samples requiring laboratory analysis
- Nearly immediate results and low limits of detection enhance applications for worker health and safety monitoring, process monitoring, or initial characterization of spills and historical releases
- Portable, hand-held (twelve pounds total weight), and can be operated by technicians with minimal training

Technology:

Current field usable portable systems have not proven reliable in selectively detecting chlorinated hydrocarbons in the 1-2 ppm range required for certain DOE applications. Recent solid-state sensor developments provide the required durability, sensitivity, and selectivity that allowed the design of a portable instrument for detection of chlorinated hydrocarbons in the vapor phase.

The sensor developed for this



instrument relies on increased conductivity when heated and exposed to hydrogen chloride (HCl) and chlorinated hydrocarbon compounds. Examples of common chlorinated hydrocarbons detected include carbon tetrachloride, trichloroethylene and tetrachloroethylene. The sensor used in this instrument is not responsive to nonchlorinated hydrocarbons, oxygenated compounds, or nitrogenated compounds. The sensor responds to chlorinated organics even when nonchlorinated organics, such as motor fuels and waste oils, are present. Many field instruments cannot selectively distinguish between chlorinated and nonchlorinated compounds.

To extend the lifetime of the sensor, an analytic duty cycle was custom-programmed to have a short exposure time coupled with a long recovery time. Generally the chemical analyses are performed in a 90 second period followed by a 5 to 10 minute zeroing time to allow sensor recovery. Through the addition of a diluter interface, sensor life is extended by restricting sensor exposure to a predetermined concentration level.

A prototype instrument was developed and is currently being used at Hanford for health and safety monitoring, remediation process monitoring, and site characterization. Based on user feedback, the developer of the instrument has simplified the operation of the instrument, improving sensor reliability and reducing the time

needed for calibration and instrument setup.

Development of a condensed phase sampler for the instrument to enable detection of chlorinated hydrocarbons in water and sludges is continuing. A range of 5.0 to 10,000 ppb of carbon tetrachloride contamination in water has been obtained using prototype equipment.

Project Conclusion:

This project was completed in October 1996. A fully portable hand-held solid-state monitoring device, the RCL MONITOR, has been demonstrated to show its capability of detecting very low levels of chlorinated organic compounds.

The RCL MONITOR has been incorporated in the Routine Quarterly Monitoring Program at the Idaho National Engineering Laboratory (INEL). Specifically, the role of this instrument in the Routine Quarterly Monitoring has consisted of quarterly groundwater and vapor sampling and analysis for chlorinated organic contamination in wells surrounding the Radioactive Waste Management Complex (RWMC). Additionally, a follow-on contract has been arranged with INEL to develop an in-situ chlorinated hydrocarbon monitor for monitoring groundwater in wells. This monitor will be a direct spinoff of the RCL MONITOR project.

In addition, an independent cost-benefit analysis has concluded that a cost savings of approximately \$185 per sample can be achieved through

the use of the RCL MONITOR as compared with standard sample collection, transportation to an offsite laboratory, and analysis.

Contacts:

Transducer Research, Inc. (TRI) is a mid-size research and development firm. TRI has significant instrument design and manufacturing capabilities through its parent, TSI, Inc. For information on this project, the contractor contact is:

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